

Naturalist Notebook

OCTOBER/NOVEMBER 1973

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*"Air, water, life, these above all
— these that in their huge cycles
constantly renew themselves —
these, with the sun's light, form the
great conditions of man's being."*



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Editor: Deborah E. Reichert

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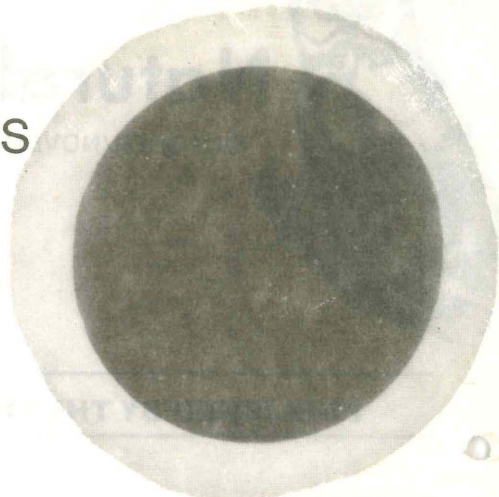
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ENERGY FLOW IN BIOLOGICAL SYSTEMS

by Elizabeth Lunn

Gasoline stations limit the amount of gasoline they can sell; we are told to drive more slowly to conserve fuel and not to use air-conditioners unless really necessary, and we hear about threatened fuel shortages for the coming winter. We are constantly being reminded that there is an "energy crisis". At the same time we are urged to collect old newspapers, glass bottles, and scrap metal for recycling. Is it possible to conserve energy by some comparable recycling process?

To answer this we need to consider some of the basic facts about energy. It is defined as the ability to perform work. According to the first law of thermodynamics, also called the law of conservation of energy, energy can neither be created nor destroyed. Its source is the sun. But to be usable by living organisms this energy must be packaged so that it can be available in small, chemically-bound units. The photosynthetic process carried on by green plants does just that. Carbon dioxide from the air plus water from the environment and energy from the sun combine to make sugar and oxygen. Using additional minerals from the soil and energy fixed in the chemical bonds of the sugar the plant can then synthesize other carbohydrates, various related compounds, fats, and proteins. Green plants must manufacture enough food during daylight hours to take care of their needs during the dark hours. Usually so much food is manufactured that some is stored in roots and stems as well as small amounts in leaves.



Animals are totally dependent, either directly or indirectly, on this stored food for their food and energy since they cannot use the sun as a source of energy nor synthesize their own food from raw materials. Animals, and plants also, take part in the next step in the transfer of energy. This occurs when the compounds which the plants made are taken apart or rearranged in the metabolic processes which build more protoplasm or release energy for the work of the cells. Small amounts of energy are passed from compound to compound as living protoplasm is made. Released energy makes it possible for cells or their component parts to move. Oxygen is required for many of these reactions. During the course of these many and complicated reactions, not all the energy that went into the manufacture of the compounds in the first place can be used. Only about 40 percent of the energy in the food that animals eat is utilized in the construction of other compounds; the remaining 60 percent is lost as heat. Furthermore, the conversion of chemical energy to mechanical energy of motion is not 100 percent efficient, and this unused energy is also dissipated as heat.

Plants and animals in nature do not live as isolated units but in biological communities or ecosystems such as a pond, a sand dune, a tide pool, or a forest. In these communities plants manufacture food and package energy from the sun. The herbivores—rabbits, ground squirrels, antelopes or buffalos eat the plants, and the carnivores—foxes, wolves, coyotes, or mountain lions eat the herbivores. When the plants and animals die they are decomposed by various bacteria and fungi, releasing elements and compounds which can be used by green plants, thus completing a food or mineral cycle. This cycle is kept going by energy, packaged during photosynthesis and passed along from compound to compound. Just as in the metabolism of individual plants and animals, the life processes of a community are not 100 percent efficient so that there is a constant loss or dissipation of energy from the community.

During the latter part of the Carboniferous Period, perhaps about 250 million years ago, much of the land became a great swamp where the huge woody ferns and fern relatives died and were subsequently converted to coal, oil, and gas. These so-called 'fossil-fuels' are our chief source of heat and energy. The energy stored in them came, as we have seen, from the sun. When we burn them that energy is lost directly as heat or is converted to other forms of energy such as electricity or

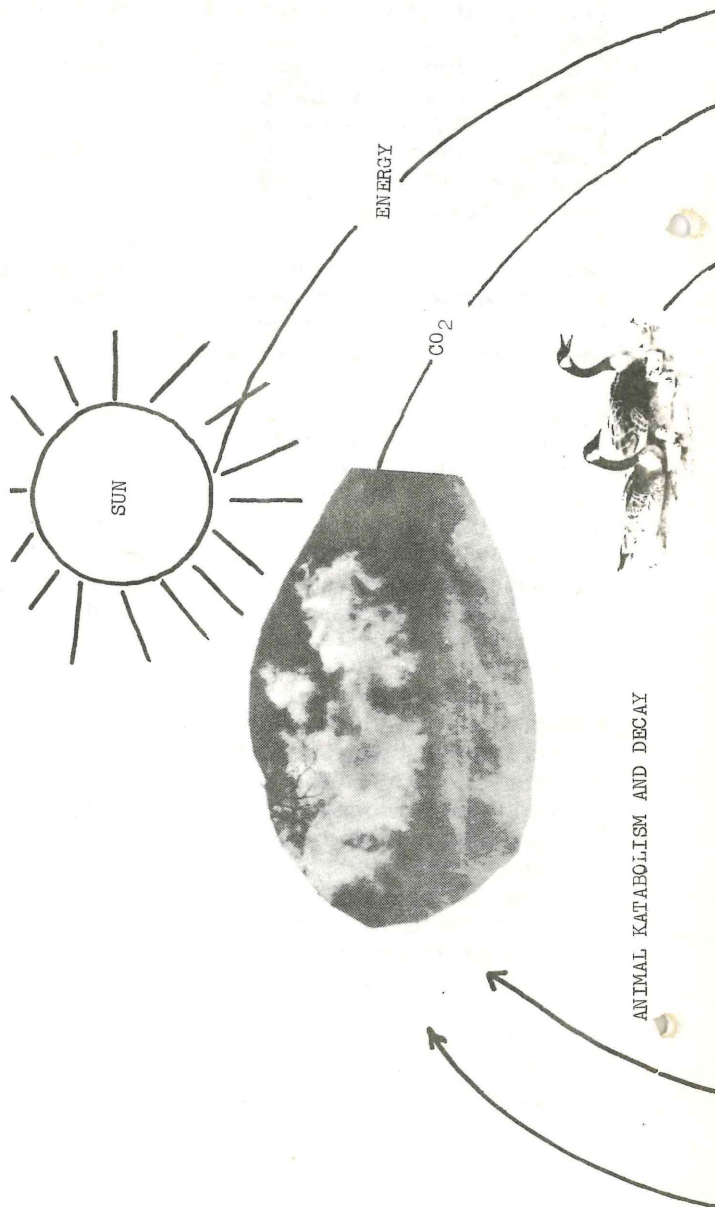
mechanical energy used to move automobiles or locomotives. Only a small fraction of the energy in fuel is utilized in such conversions and in the end all the energy is dissipated as heat or as work done. While the carbon dioxide and other residues of fuels released during combustion are thus made available for reuse by plants, the energy released is not.

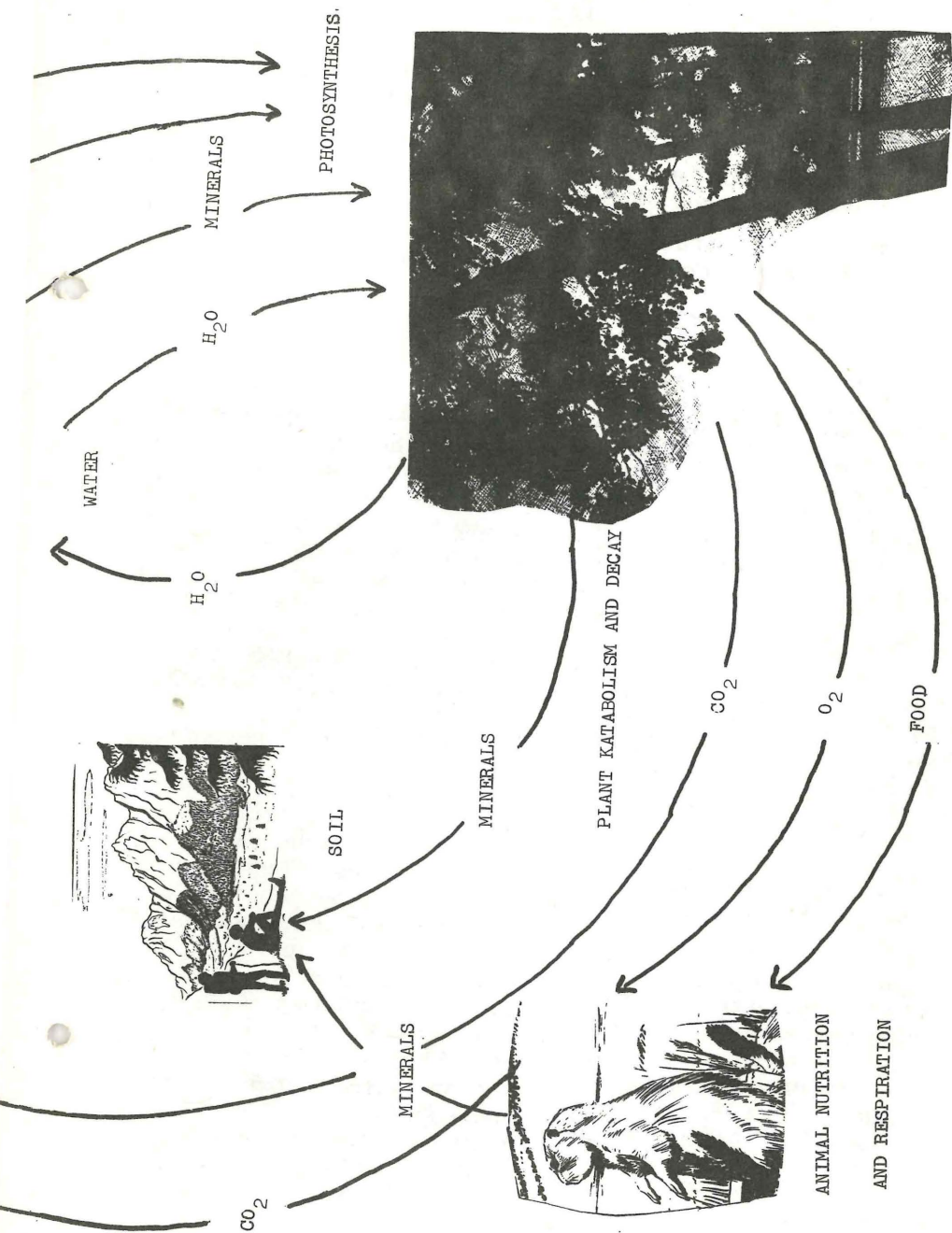
Since the law of conservation of energy says that energy cannot be created nor destroyed it might seem that we should be able to recycle and reuse energy as we do paper or scrap iron. But while energy can be transferred by means of chemical reactions there is in each transfer the probability of some dissipation of energy. Thus we see that the second law of thermodynamics (which states that during energy transformation there is a degradation of energy from a concentrated to a dispersed form) is applicable to the life processes of organisms and communities. This dispersed form of energy cannot be used to synthesize the building blocks of protoplasm. So, unlike the physical materials of our biological systems which can be circulated and reused many times, energy flows through a biological system, gradually becoming dissipated and lost to that system as it flows. It is probable therefore, that as stores of fossil fuels are depleted, we may be headed for an energy crisis unless other than photosynthetic-dependent methods of harnessing and dispensing energy are made practical.

Dr. Lunn is Professor Emerita of Biology at Lake Forest College in Lake Forest, Illinois. Her current studies include an ecological survey of Zion State Beach Park in northern Illinois.

THE ENERGY CYCLE

This diagram illustrates the relationships between plants and animals and the dependence of both upon sunlight and the non-living materials of the earth. The energy of the sunlight is the only part of the cycle that is not returned to its source for reuse.





TO EVERY THING

by

DEBORAH REICHERT

To every thing there is a season, and a time for every purpose under heaven:

A time to be born, and a time to die;

A time to plant, and a time to reap;

A time to kill, and a time to heal;

A time to break down, and a time to build up;

A time to get, and a time to lose;

A time to keep and a time to cast away;

A time to love, and a time to hate;

A time of war, and a time of peace.

Ecclesiastes

Since Biblical times men have been aware of cycles in nature. Long before "ecology" became popular, human life depended on and varied with seasonal change. Winter meant hardship and a search for food and shelter; spring brought warmth and welcome rain; summer was a time of growth and planting; autumn a time of harvest and preparation. Men noticed and recorded the changes in the stars, the position of the sun, and the phases of the moon. Early scientists may not have understood the reasons for these cycles, but they were acutely aware of their occurrence.

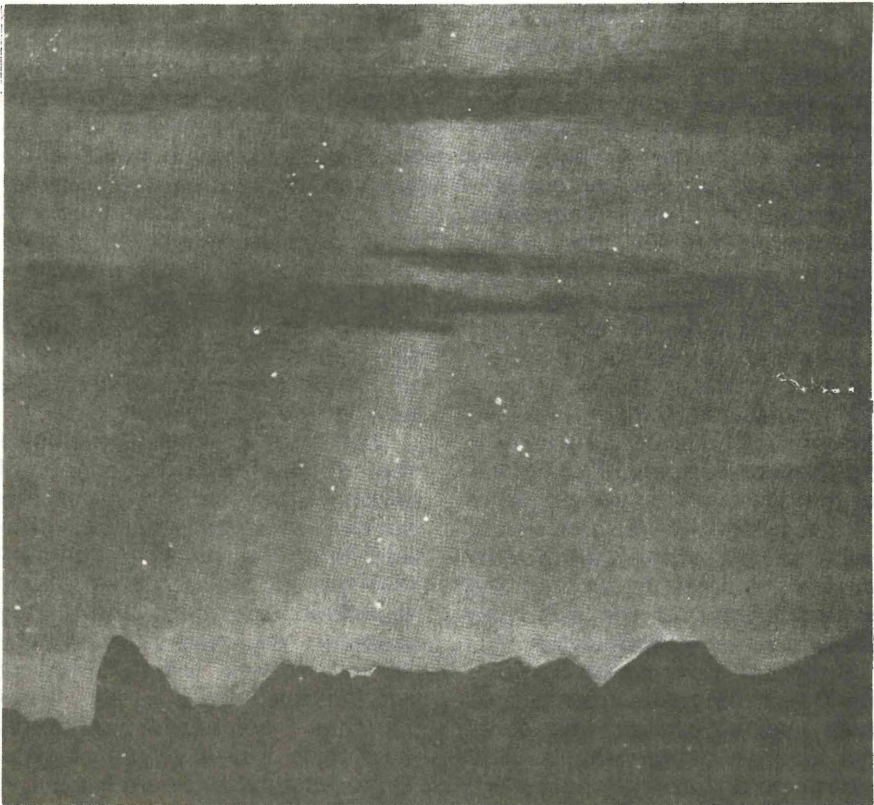
Our lives to a great extent still depend on natural cycles. Our awareness has taken on an aesthetic appreciation: we drive to the country to see the autumn colors, to the mountains for snow and recreation, to the seashore in the summer. Our calendars and clocks are coordinated with natural time and change. Our modern comforts prevent hardship in inclement weather, but we still listen with keen ears to the daily forecast.

Nature provides animals with

ways to cope with seasonal variation. Some mammals, such as the snowshoe hare and arctic fox, change color according to the season. Their white coats in winter and brown coats in summer help camouflage these animals from predators. Birds and even some butterflies migrate to warmer climates as winter approaches. Many insects spend the winter in egg masses or cocoons, emerging as larvae with spring and an abundant food supply. Some animals hibernate in cold weather, spending the winter sleeping or semi-conscious. Their reduced heart and respiration rates prevent starvation and nearly certain death. Nature "recycles", too. Leaves and dead trees become humus through the process of decomposition. The humus eventually becomes rich black dirt, though it takes up to 100 years to make an inch of soil! Antlers and bones are used by rodents as a source of calcium. Dead animals are food for scavengers such as coyotes and ravens. Plants "recycle" carbon dioxide into oxygen through photosynthesis. Food chains are a classic example of natural cycling: the primary pro-

ducers (plants and herbivorous animals) feeding the secondary producers (owls, foxes), which in turn are preyed upon by consumers (wolves, coyotes, and man). Even the lowly fungus plays a part in decomposition and recycling. Lichens, an often unnoticed group, actually play a role in the break-down of barren rock, leading to pioneer plant succession. When a forest burns, bracken fern and various sedges and grasses quickly come in to start the cycle of growth over again.

Our awareness of natural cycles may not be as acute as our ancestors', but we cannot avoid the influence of change in nature. Man is just beginning to realize that he, too, is part of the natural process. Of all animals, man can most easily alter his environment—often to his own discomfort and dismay. We must become more attuned to natural change. We are inextricably part of the web of life, and our realization of our role in the natural chain might someday save us from extinction.



D. Owen Stephens, 1937.

MICRO CYCLES

by
Matthew Rosen

We are all familiar with the shedding of leaves, temporary disappearance of flowers, migration of birds, freezing of streams, and hibernation of animals; but what happens to the smaller, fragile species of flora and fauna? Is it possible for the microscopic fungal filaments to withstand the harsh offerings of winter? Many insects are not much larger than the head of a pin, yet they, too, manage to survive in an apparently hostile environment. What protective mechanisms has Nature endowed these diminutive creatures with in order that they may not only persevere but prosper?

Among the most destructive disease agents in the United States, *Ceratocystis ulmi*, the Dutch elm disease fungus, has been responsible for the shockingly rapid demise of countless stately American elms (*Ulmus americana*). Ironically, it is the dead or dying trunk of the host that provides life-enabling shelter for the pathogen. By growing within the xylem (water conducting cells) of the tree, *Ceratocystis ulmi* is insulated from both the antiseptic rays of the sun, and freezing winter temperatures.

Snug and cozy within its host, the D.E.D. fungus is free to produce asexual conidia and coremia spores at its leisure. The conidia and coremia spores are both formed at its leisure. The conidia and coremia spores are both formed without fertilization.

Two tiny beetles, *Scolytus multistriatus* and *Hylurgopinus rufipes* are also inhabitants of dead or dying elms. Carving out neat

little tunnels in the wood, the females lay their eggs in small niches spread at various intervals along the gallery walls. Always cramped for space, *Ceratocystis ulmi*, if present in the tree, cohabits the bark beetle's nurseries, producing thousands of sticky coremia spores.

Having been kept warm under their blanket of wood, the young adult beetles emerge from under the bark in the spring, shortly after bud break. Their bodies covered with the spores, the famished insects fly to the crotches of near-by healthy elms. While gorging themselves on the tender new shoots, the beetles inadvertently deposit the spores in their feeding wounds. Thus, after having been exposed to the hostile outside world for, at most, only a few hours, *Ceratocystis ulmi* is efficiently moved into a favorable new "home".

But what of micro-organisms that do not have the benefit of shelter? How can they possibly survive freezing, or even sub-zero temperatures? The common leaf-spotting fungi serve as an excellent example. During the summer, you have probably observed Norway, sugar, silver, or red maple trees with black blotches splattered randomly over their normally green leaves. Quite fittingly, the name given to this disease is tar spot of maple. The pathogen is an ugly looking but innocent fungus, *Rhystima acerinum*.

As long as foliated maple trees remain plentiful, and the weather is warm-hot, *Rhystima acerinum*

literally lives in the lap of luxury. The leaves of the maples provide both a house and nourishment. No need to worry about overcrowding or lack of food. If the neighborhood deteriorates or "manna" becomes limited, all the fungus has to do is produce spores, latch on to a passing wisp of wind, and travel forth to "greener pastures".

Once the crisp autumn nights arrive, "easy street" abruptly vanishes for *R. acerinum*. No longer actively producing food, the foliage loses its rich green coat in favor of a more seasonal yellow-red one. Our friend the fungus is faced with two serious problems: lack of shelter from the cold and starvation. No longer can it "hop" from leaf to leaf, and tree to tree "knowing" that better times are just around the corner

No longer can it bask in the warm rays of the sun. Winter is coming.

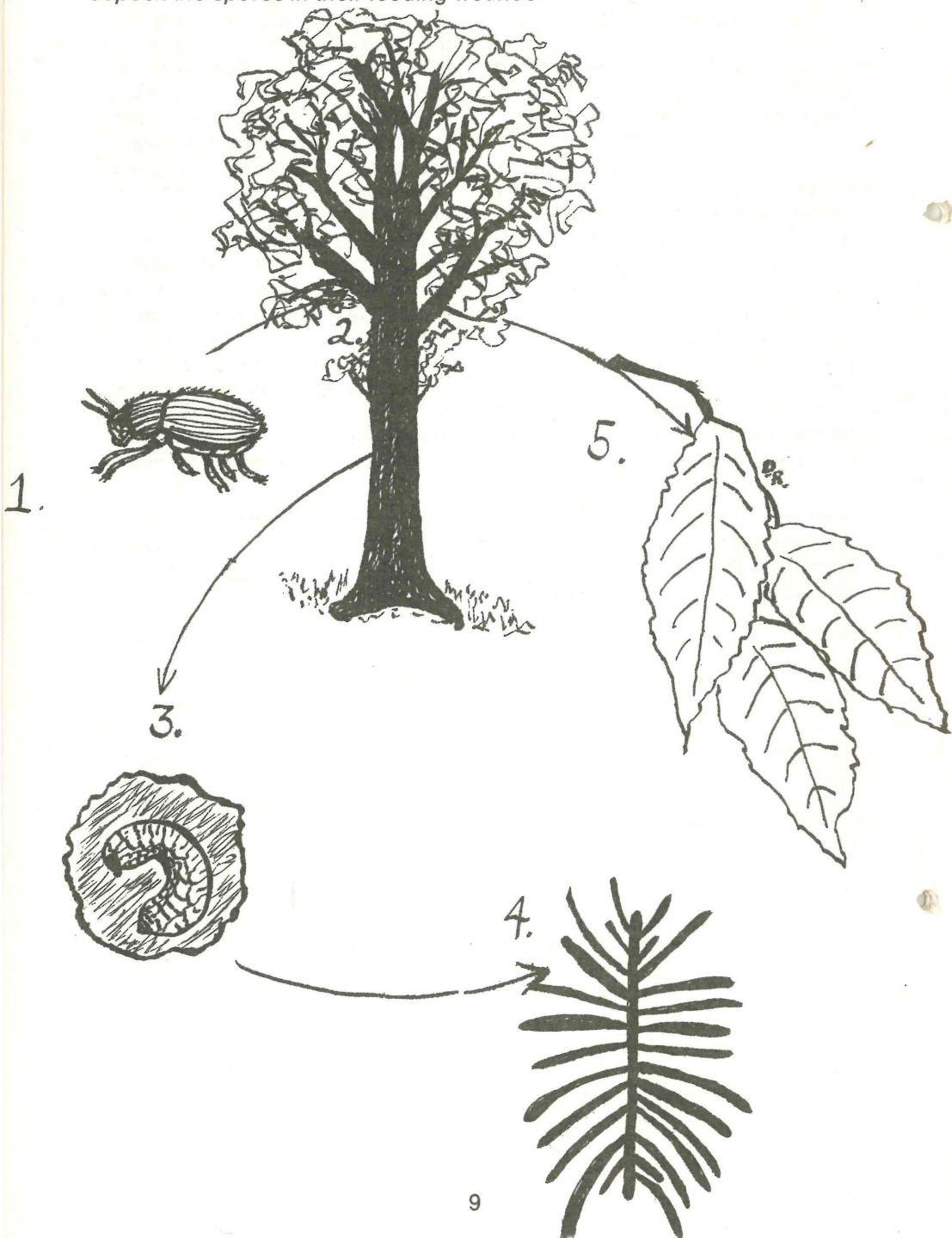
Faced with the very real possibility of extinction, *Rhystima acerinum* simply alters its life style. As the leaves turn color, and gradually fall from the tree, the fungus ceases to produce thin-walled, short-lived conidiospores; rather, it forms tough walled, weather resistant sclerotia, underneath which the sexually produced ascospores can snugly hibernate until "April showers bring May flowers."

And thus throughout the woods life goes on. With the onset of spring a new generation is born. Nature has, through fascinatingly intricate devices, attuned the life cycles of her microscopic flora and fauna, enabling them to persevere during the harsh winter months, so they, too, can "blossom" forth the following spring.

Matthew Rosen teaches Environmental Horticulture at McHenry County College in Crystal Lake, Illinois. He received an M.F.S. degree from the Yale School of Forestry, and a B.S. from Cornell University.

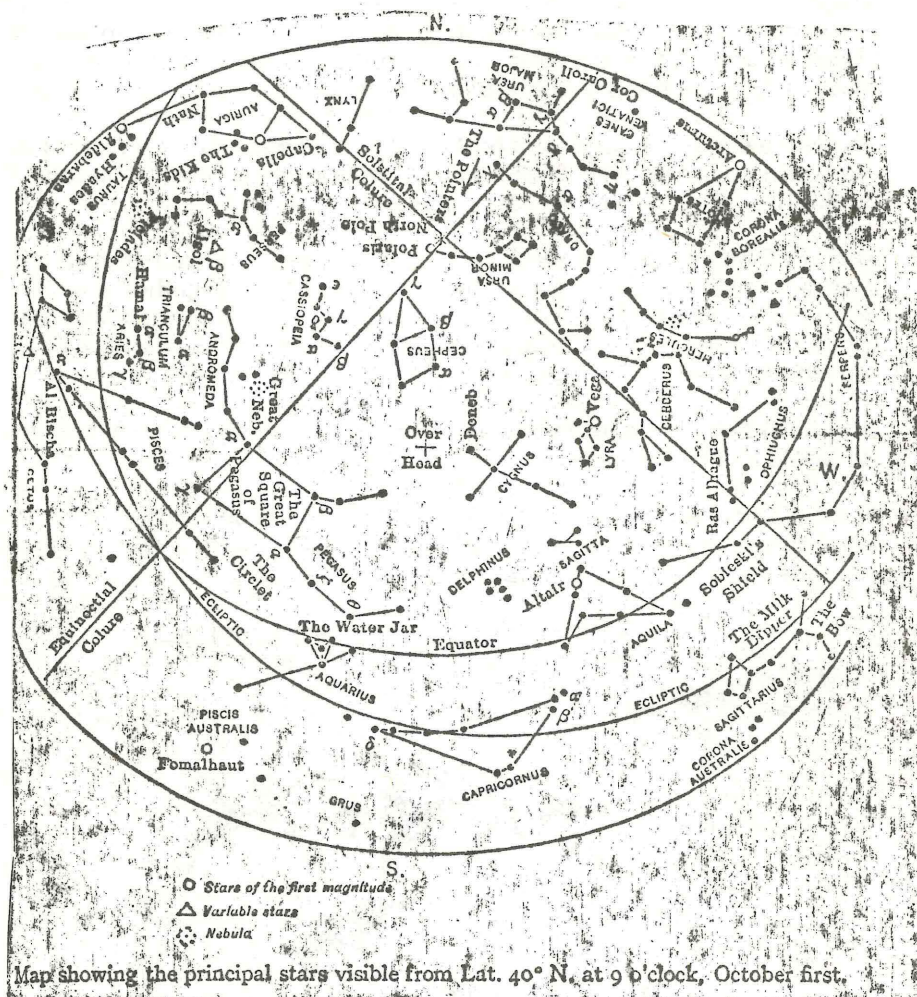
THE LIFE CYCLE OF *Ceratocystis ulmi*

(1). The small elm bark beetle carves out a gallery in a dead or dying elm
(2). Along the walls of the gallery (3). the female lays eggs in little niches.
The coremia stage of the fungus occurs in the gallery (4). When the young
adults emerge in the spring, they immediately fly to near-by healthy elms
to feed in the crotches of the new growth (5). Unknowingly, the beetles
deposit the spores in their feeding wounds.



THE AUTUMN SKY

In the past few years, we have observed moonshots, the launching of satellites and weather probes, and, most recently, the mission of Skylab II. But how many of us take a moment to look at the skies at night? Star-gazing is a fascinating and educational hobby. Using this chart of the autumn constellations, you should be able to identify the star formations which have sparked the imaginations of poets, scientists, navigators, and astrologers for thousands of years. The chart is adapted from *A Field Book of Stars* (Olcott, William Tyler. New York: G.P. Putnam's Sons). You may want to use a telescope to get a closer view, but most of these constellations should be visible on a clear autumn night.



IF I WERE THE WIND

by Aldo Leopold

The wind that makes music in November corn is in a hurry. The stalks hum, the loose husks whisk skyward in half-playful swirls, and the wind hurries on.

In the marsh, long windy waves surge across the grassy sloughs, beat against the far willows. A tree tries to argue, bare limbs waving, but there is no detaining the wind.

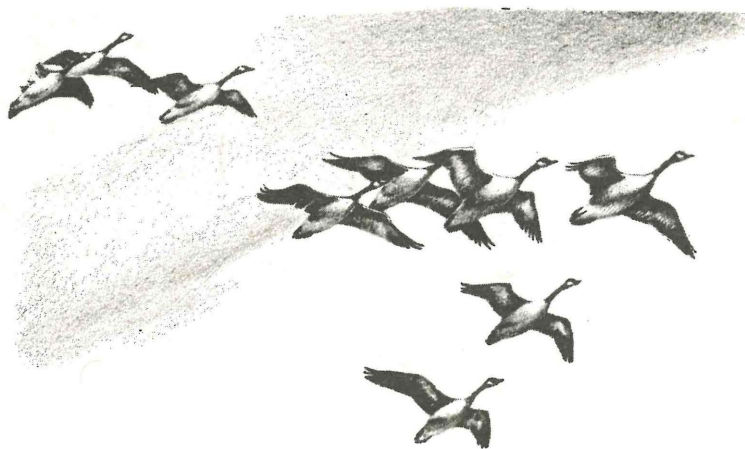
On the sandbar there is only wind, and the river sliding seaward. Every wisp of grass is drawing circles on the sand. I wander over the bar to a driftwood log, where I sit and listen to the universal roar, and to the tinkle of wavelets on the shore. The river is lifeless: not a duck, heron, marsh-hawk, or gull but has sought refuge from the wind.

Out of the clouds I hear a faint bark, as of a far-away dog. It is strange how the world cocks its ears at that sound, wondering. Soon it is louder: the honk of geese, invisible, but coming on.

The flock emerges from the low clouds, a tattered banner of birds, dipping and rising, blown up and blown down, blown together and blown apart, but advancing, the wind wrestling lovingly with each winnowing wing. When the flock is a blur on the far sky I hear the last honk, sounding taps for summer.

It is warm behind the driftwood now, for the wind has gone with the geese. So would I—if I were the wind.

From A Sand County Almanac, With Other Essays on Conservation from Round River by Aldo Leopold. Copyright © 1949, 1966 by Oxford University Press, Inc. Reprinted by permission.



FIELD NOTES JULY—AUGUST 1973

The fall migration of shore-birds began around July 5. With the extremely hot weather during August, many small ponds dried up, thus concentrating the shore-birds along the shoreline. **WATERFORD: A ROSEATE TERN** seen on July 1 along the shore remained there throughout the month. A **COMMON LOON** was observed there, also on July 1. Two **SANDERLINGS** were spotted along the beach on July 5, and a **SOLITARY SANDPIPER** was seen on July 6. A **CAROLINA WREN** was observed throughout the month of August. A lone **BONAPARTE'S GULL** was seen in Harkness Cove on August 13. A **TRAILL'S FLYCATCHER** was observed on August 27.

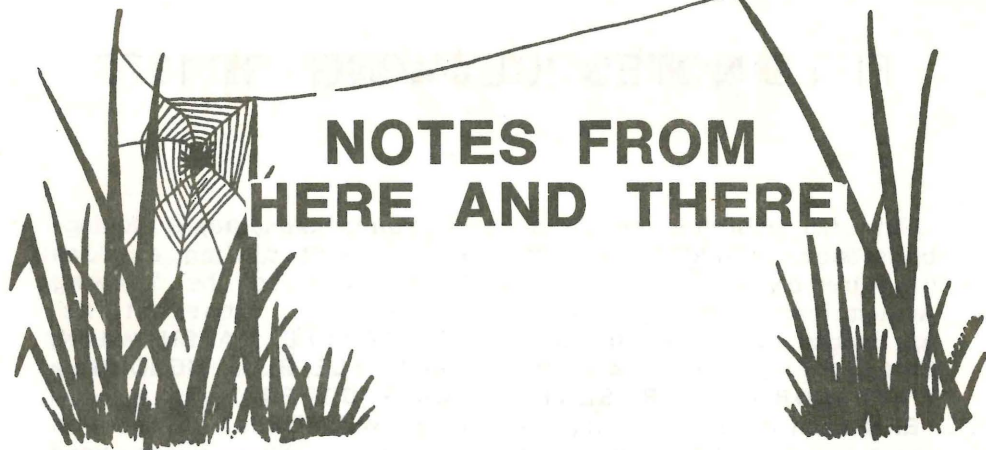
NEW LONDON, NANTIC, OLD LYME: A YELLOW-THROATED VIREO was seen outside the classroom at TSC on August 10. Three **CEDAR WAXWINGS** were seen in Old Lyme on August 24, and a **BLUE-WINGED TEAL** was found in Niantic August 28.

GROTON, MYSTIC, STONINGTON: Birders found a variety of interesting birds on July 1 at Barn Island. These included: a pair of **GADWALL**, four **LITTLE BLUE HERONS**, and three **GLOSSY IBIS**. Other observations on the same date included a **WILSON'S PETREL** and **COMMON LOON** near Sandy Point Island, Stonington. Four **GLOSSY IBIS** were observed soaring over the Groton dump on July 23. A rare visitor to this area, the **YELLOW-CROWNED NIGHT HERON**, was seen at Groton Long Point July 28. Another rare visitor, the **MANX SHEARWATER**, was

seen on the same day in Stonington. August birding at Barn Island produced the following interesting observations: **LONG-BILLED MARSH WREN**, five **LITTLE BLUE HERONS**, a **LEAST BITTERN**, and the unusual **WHIMBREL**, all seen on August 6. Other observations there on August 12 included a **VIRGINIA RAIL** and four **GLOSSY IBIS**. Bird banding at Barn Island during the months of July and August produced many **LEAST** and **SEMI-PALMATED SANDPIPERS**. Birders at the Peace Sanctuary found a **BROWN CREEPER** August 25 and a flock of 30 immature **BONAPARTE'S GULLS** feeding on insects while flying over the Mystic River. The **YELLOW-CROWNED NIGHT HERON** was seen again at Groton Long Point on August 29, along with 25 **BLACK-BELLIED PLOVERS**, **RUDDY TURNSTONES**, and **YELLOWLEGS**. An injured **SORA RAIL** was found on the road leading into Barn Island on August 31.

NAPATREE POINT, RHODE ISLAND: Birders here made the following observations on July 30: 8 **SEMI-PALMATED PLOVERS**, 7 **PIPING PLOVERS**, 50 **RUDDY TURNSTONES**, a **COMMON LOON**, a **KNOT**, and 25 **SHORT-BILLED DOWITCHERS**. Other observations there included two **COMMON LOONS** August 5, and a **RED-BREASTED MERGANSER** August 25.

Contributors: G. Bissel, T. De-Gange, F. Haeni, K. Haeni, C. Kashanski, Mr. and Mrs. S. Knox.



NOTES FROM HERE AND THERE

FISH AND PETUNIAS may come to rival canaries as pollution detectors, according to *Science News*. Canaries at one time were used to give early warning signals of pollution in mines. Now various plants, including petunias, are being tested for clues to airborne pollutants. Fish also respond to various aspects of pollution and could provide instantaneous gauges of water pollutants.

SOME APARTMENT DWELLERS AND WORKERS IN OLDER OFFICE BUILDINGS IN NEW YORK CITY MAY BE BREATHING AS MUCH CARBON MONOXIDE from vehicles as are pedestrians walking on the sidewalks below. Investigators from the Environmental Protection Agency found that the carbon monoxide at ground levels was approximately the same as carbon monoxide concentrations inside and outside the buildings. They reported that even upper floors had high levels of carbon monoxide. Measurements of the pollutants on the thirty-second floor of one apartment building located over a highway exceeded federal standards 19.7 percent of the time. The investigators recommended sealing off lower levels of new buildings, spacing new buildings to permit wind dilution of pollu-

tants, and installing adequate forced air ventilation systems in carbon monoxide traps such as parking garages and elevator shafts.

THE THAMES SCIENCE CENTER LIBRARY has been given a life membership to *Connecticut Woodlands* magazine by Mrs. Mildred Abbot. This lovely magazine will be a valuable asset to the library.

THE SUPERSONIC TRANSPORT still isn't dead, even after the crash of Russia's TU-144 in Paris last June. Work on Russia's SST program is only marginally behind schedule and designers have already started working on a second generation faster-than-sound transport.

A RECENT BOOK ENTITLED THE LAST PLAY talks about the world's energy crisis and how the giant energy companies do business. Some of the interesting facts put forward include: the technology exists for converting human and animal wastes into oil. One ton of waste would become one barrel of oil. At that rate, this country could produce two billion barrels of oil—40% of what it consumes—in this manner. *The Last Play* is available from E.P. Dutton and Co., Inc., 201 Park Ave. S., New York, N.Y. 10003 for \$10.

RECYCLE

Recycle Notes: Solitaire Games

Leaping Men

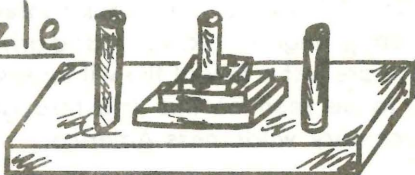


Materials: Board with eleven squares; 5 X markers (or perhaps red markers); and 5 O (or black markers).

Object: to move all X markers to opposite side of board and O markers on other side.

Rules: Move one marker at a time—forward only. You may jump single markers, however you may not have two markers occupy the same space.

Pyramid Puzzle



Materials: oblong piece of wood used as a platform with three wooden sticks or dowels nailed into the platform. Five square sponges cut into graduating sizes with holes to fit over the dowels.

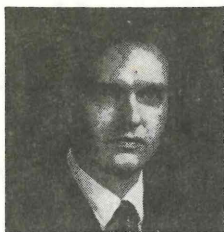
Object: to recreate the pyramid on an outside post.

Rules: You may move only one piece at a time and never place a larger piece on a smaller piece. This can be done by playing them back and forth using all three posts. You must begin on the center post and move the pyramid to an outside post.

RECYCLE is located at: The Children's Museum
Resource Center
The Jamaicaaway, Boston, Mass.
552-4800 ext. 41

This game is from "Recycle", available from the Children's Museum for \$1.00 per copy.

AUDUBON WILDLIFE FILMS



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Tom Sterling
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Sunday
December 2, 1973

Edgar T. Jones
"Canada's Mountain
Wilderness"

The rufous hummingbird, the incredible harlequin duck of mountain streams, the giant blue grouse in courtship, Cooper's hawk and western tanager—all inhabitants of the Canadian Rockies—fill the screen in "Canada's Mountain Wilderness," by Edgar T. Jones of Edmonton, Alberta. Mountain sheep, goats, and elk are featured too, in a program which will delight all those who enjoy the out-of-doors, and who seek a respite from the hustle and bustle of everyday life.

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